1169718

URS

October 15, 2010

Ms. Jan Christner
URS Operating Services
1099 18th Street, Suite 710
Denver, CO 80202

Subject: Hydrologic, Hydraulic, and Geotechnical Assessment for Argentine Mine / St. Louis Tunnel Sediment Settling Ponds, near Rico, Colorado
Contract No. EP-W-05050, START 3, Region 8
Project No.: 22241923

Dear Ms. Christner:

We have completed our preliminary assessment at Rico Argentine Mine. Our assessment included a site assessment of the existing sediment settling pond embankments (specifically Pond 18) and hydrologic and hydraulic analysis of the Dolores River adjacent to the sediment settling ponds associated with the St. Louis Mine adit outfall north of Rico, Colorado, see Attachment 1. Our site visit was conducted on September 20 and 21, 2010 and was performed by Bob Christensen and Michael Nelson from URS. The following report summarizes our analyses and observations. A site layout, results of hydrologic modeling and photographs taken during the site visit are provided as attachments to this report.

HYDROLOGIC AND HYDRAULIC EVALUATION

URS Operating Services (UOS), in support of the Environmental Protection Agency (EPA), has requested that URS perform a hydrologic and hydraulic analysis of the Dolores River adjacent to the settling ponds associated with the St. Louis Mine adit outfall. The study reach is along a reach of the Dolores River with embankments along the east side containing a series of sediment settling ponds.

Hydrologic Analysis

The Dolores River in this study reach is a Federal Emergency Management Agency (FEMA) Zone A Floodplain. FEMA defines a Zone A floodplain as *"Areas subject to inundation by the 1-percent-annual-chance flood event generally determined using approximate methodologies. Because detailed hydraulic analyses have not been performed, no Base Flood Elevations (BFE) or flood depths are shown."* FEMA has provided an approximate floodplain in this area, shown on the attached Flood Insurance Rate Map (FIRM) panel, see Attachment 2, but provides no information regarding flow rate.

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The Colorado Water Conservation Board (CWCB) provides regional regression equations for estimating the 100-year flow at sites of interest. The document, *Guidelines for Determining 100-Year Flood Flows for Approximate Floodplains in Colorado, Version 6.0, June 2004*, was referenced. The document provides a basin-specific regression equation for the Dolores River Basin applicable for drainage areas ranging from 2 to 1,080 square mile drainage area. The equation is:

$$Q = 213.8\ (A)^{0.601}$$

Where:

A = Drainage Area, square miles
Q = 100 year peak flow, cubic feet per second (cfs)

A United States Geologic Survey (USGS) stream flow gage, USGS 09165000 Dolores River Below Rico, CO, has operated since 1951. The published tributary area for this gage is 105 square miles. The gage is actually located 4 miles south (downstream) of the Rico community. The study area is approximately 1 mile north (upstream) of Rico. USGS quad maps were used to delineate the tributary area between the Rico gage and the downstream limits of study site, which is 34.2 square miles, making the tributary area at the study site is 70.8 square miles. Application of the regression equation indicates a 100-year flow rate for the Dolores River at the study site is 2,770 cfs.

The USGS recently updated their regression equations for Colorado and these are presented in the document, *Regional Regression Equations for Estimation of Natural Streamflow Statistics in Colorado, Scientific Investigations Report 2009-5136, 2009*. This document provides equations for the full array of flood flow frequencies in the following equations.

Recurrence interval, years	Equation	Computed Flow Rate, cfs
2	$Q_2=10^{1.67}A^{0.64}A_{7500}^{-0.10}$	470
5	$Q_5=10^{2.13}A^{0.62}A_{7500}^{-0.19}$	840
10	$Q_{10}=10^{2.36}A^{0.61}A_{7500}^{-0.23}$	1,160
25	$Q_{25}=10^{2.61}A^{0.60}A_{7500}^{-0.27}$	1,660
50	$Q_{50}=10^{2.77}A^{0.59}A_{7500}^{-0.30}$	2,030
100	$Q_{100}=10^{2.91}A^{0.59}A_{7500}^{-0.33}$	2,460
200	$Q_{200}=10^{3.04}A^{0.58}A_{7500}^{-0.36}$	2,800
500	$Q_{500}=10^{3.21}A^{0.58}A_{7500}^{-0.39}$	3,640

Where:

A= Area in square miles
A_{7500} = Area above 7500 foot elevation (in this case, all area)

An examination of the annual peak flow for the Rico stream gage (drainage area of 105 square miles) indicates that the gage has operated continuously since 1952, and includes 56 years of data. Of the 56 years, five years have had peak annual flow exceeding 2,000 cfs and the peak flow is 2,170 cfs in 1984. The data appears to be consistent with the regression equation results. Applying 105 square miles to the regression equations yields a 50-, and 100-year flow rate of 2270 and 2730 cfs respectively, which is consistent with the gage data for the years of record.

The hydrologic analysis does not consider the inflow into the ponds during storm events. Detailed topographic information would be needed for this assessment. Pond embankment stability could be vulnerable due to ponds overtopping embankments.

Hydraulic Analysis

Four (4) river cross-sections were surveyed using an arbitrary vertical benchmark (the elevations in the study reach are in the range of 8780 feet above level and the survey is based on an arbitrary ground elevation datum of 1000 at the first instrument set up location). Cross-sections selected span the study reach over a length of approximately 2700 feet. The downstream section is adjacent to the upstream extent of Pond 5 and the upstream cross-section is just upstream from Pond 18. In addition to the cross-sections, the top of embankment and the water surface in the ponds adjacent to the embankment were surveyed.

The cross-sections and flow rates were used in a HEC-RAS (Version 4.1.0) analysis (Attachment 3) in order to provide insight into the expected water surface profiles and flow conditions during the 100-year runoff and the other calculated runoff events. The model compiled is based on a downstream boundary condition of normal flow with a channel slope of 0.015. This slope was measured from the USGS topographic map for the Rico Quadrangle. Roughness coefficients selected were 0.04 for the channel and 0.10 for thickly wooded areas on the west side of the channel, between the channel and the State Highway 145. The perennial spring-fed channel between the eastern bank of the Dolores River and Pond 18 was assigned a roughness of 0.05.

Table 1 provides survey and hydraulic model results identified for locations chosen based on the assumed center of each of the tailing ponds.

Table 1. Survey Information and Hydraulic Model Results

(1) Pond ID	(2) Distance Upstream, ft	(3) River Channel Invert Elevation, ft	(4) 100-Year Water Surface Elevation, ft	(5) Lowest Embankment Elevation, ft	(6) Pond WS Elevation, ft
5	0	991.6	997.3	999.6	996.2
6	100	993.5	999.2	1000.0	997.2
7	320	997.8	1003.6	1004.4	1003.3
8	610	1003.4	1009.3	1010.2	1007.3
9	815	1007.3	1013.3	1013.9	1011.5
11	1120	1012.0	1018.3	1028.8	1025.1
12	1420	1017.0	1023.2	1030.7	1025.9
14	1640	1021.1	1026.8	1030.8	1027.3
15	2180	1031.4	1035.6	1038.6	1037.1
18	2710	1041.5	1044.2	1045.6	1044.4

Explanation of Columns

(1) Pond ID – See Attachment 1 with pond designations. Only ponds directly adjacent to embankment are entered into table.
(2) Distance Upstream – Approximate distance from most downstream cross-section to location adjacent to upstream end of pond. This distance is used to complete columns (3) and (4) based on HEC-RAS model interpolations.
(3) Channel bottom invert elevation interpolated from HEC-RAS (based on arbitrary datum.)
(4) Water surface elevation interpolated from HEC-RAS (based on arbitrary datum.)
(5) Lowest Embankment Elevation is typically based on embankment along river adjacent to pond at the downstream end of the pond (based on arbitrary datum).
(6) Surveyed pond water surface elevation (September 21, 2010).

Discussion of Results

Two regression equations were computed for flow rate. The higher flow rate generated by the CWCB equation of 2766 cfs was used for the 100-year flow condition. The HEC-RAS analysis that was conducted is an approximation of the water surface profiles and flow conditions. A boundary condition, assuming flow is not restricted at the downstream end of the study reach, was used in this analysis. The existing bridge crossing approximately 2000 feet below the downstream limits of study was not considered. The bridge is a single span of approximately 60 feet long with a low chord approximately 12 feet above the channel bottom. It is not known if this bridge crossing impacts the water surface profile within the study reach.

Near the upstream extent of the study reach, there is a secondary stream channel paralleling the river on the east side between the river and Pond 18. The surveyed cross-section indicates that this channel is actually at a lower elevation than the river bottom. The performance of this channel is not known. For this model, we assumed that the parallel channel will fill to the same level as the river. This is a conservative assumption when considering the channel's impact on the Pond 18 embankment. The field investigation revealed that the high land mass between the channel and the river extends upstream and appears to narrow, but it is not known where and at what elevation the river begins to overtop into the channel, or to what extent flow backs into the channel from downstream.

Table 1 indicates that the 100-year flow will not overtop the embankment. In this regard, the results in the table can be considered conservative because it compares the HEC-RAS water surface elevation at the upstream limits of the pond and the low embankment near the downstream limits of the pond.

Four (4) cross-sections were surveyed and incorporated into the HEC-RAS model. The downstream cross-section is at the upstream extent of Pond 5 (section 10). The other three cross-sections are located adjacent to the upstream limits of Ponds 9, 12 and 18 respectively. Table 1 indicates that the 100-year flow will not overtop the pond embankments. In this regard, the results in the table can be considered conservative because it compares the HEC-RAS water surface elevation at the upstream limits of the pond and the low embankment near the downstream limits of the pond. The results of the analysis for other flow frequencies indicate that all river flows will be contained below the top of the pond embankment with the exception of the 500-year event, which begins to overtop at a number of locations.

Channel velocities calculated in the HEC-RAS model range from 10.5 to 11.5 feet per second for the three downstream cross-sections. For the upstream cross-section, flow velocities are computed as 7.5 feet per second. The lower velocity is attributable to the wider section where flow is assumed to occupy the parallel channel. If the Dolores River contains the full flow and does not impact the parallel channel, the river level will be higher than computed at the upstream extent of the model and the river velocity will be higher.

In some locations riprap has been placed on the embankments holding the tailing ponds. Consideration should be given to a more detailed analysis of the erosion potential along the pond embankments. This would include a detailed inventory of the existing riprap, the material behind the riprap, and the expected depth of flow and velocity distributions across the channel.

When considering the performance of the tailing ponds, consideration should be given for river tailwater backing into the ponds; large river flow events could push water back into the tailing ponds.

GEOTECHNICAL EVALUATION

URS was also asked to conduct a site visit to observe the existing condition of select sediment settling pond embankments, specifically Pond 18. Our observations were to be limited to those visible features on the slopes, crest and down stream areas that appear to be related to embankment stability. Our primary focus was to be on drainage patterns, evidence of subsidence, erosion, seepage, and surface instability. The following summarizes our understanding of the historical operation of the settling ponds, our observations, followed by conclusions and recommendations. Photographs documenting the existing condition of the pond embankments are located in Attachment 4.

Understanding of Historical Operation

Based on discussions with EPA and UOS, a series of 19 ponds were constructed as part of the mining operation; some of the ponds were used for storage of iron oxide tailing during operation of a sulfuric acid plant. The quality and methods of the embankment construction are, currently, unknown. Through consolidation or for other reasons, only 16 of the original 19 ponds remain. The ponds in their current configuration served as settling ponds associated with a lime treatment system used to treat water discharging from the St. Louis Tunnel in the 1980s and 1990s. The lime treatment system is no longer operational; however the tunnel discharge continues to flow into Pond 18 and cascades through a series of 9 additional ponds (shown as Ponds 15, 14, 12, 11, 9, 8, 7, 6, and 5 on Figure 1) before it is discharged to the Dolores River. The lower ponds, Ponds 1, 2, 3, and 4, are not part of the water treatment system. Results of recent sampling and testing of water discharging to the Dolores River indicate that metal concentrations are higher than previously recorded. The ponds have continued to collect sediment/sludge and have not been dredged. The quantity and depth of sediment collected in Pond 18 is uncertain, but may require dredging. Because the quality and construction methods of the existing embankments are unknown, it is uncertain if the embankments are stable and if they will support dredging equipment.

Site Observations

The Pond 18 embankments appear to be in good condition. The embankments appear to have been constructed of alluvial material, based on surface soils observed along the embankment. The crest of the embankment is covered with a thin layer of crushed stone, presumably to limit damage from vehicular traffic. Vegetation, ranging in size from grasses to trees taller than 10 feet, is present on areas of the embankment, mostly along the north side, which skirts the Dolores River. The downstream embankments, along the river, are lined with riprap ranging in size from 6 to 36 inches. The freeboard depth was estimated to be 1.2 feet, based on survey data. The height of the embankment ranges from approximately 4 feet on the east end to approximately 10 feet on the west end. The average downstream slope ranges from approximately 1H:1V to 2H:1V (Horizontal:Vertical).

The spillway consists of a broad crest weir approximately 5 to 10 feet across and lined with cobbles ranging in size from 6 to 18 inches. Three culverts constructed within the embankment, near the spillway, also discharge water from Pond 18 to Pond 15, see Attachment 1. Two culverts, side-by-side, located south of the spillway appeared to be functional. Both contained soil as a result of in-silting and appeared to be operating at approximately three-quarters of their design capacity, when flowing full. The third culvert was situated directly beneath the main spillway and was actively spilling water. The main spillway was not spilling water, but appeared to have carried water at some point, based on discoloration of the rip rap. At the time of the site visit, the main spillway and associated culverts were free of debris blocking the inlet. The spillway appeared to be in good condition with a small amount of debris located at the discharge point to Pond 15.

No apparent signs of settlement or slope instability were observed on the embankment during the site visit. Erosion along the interior banks of the pond appeared to be minor; related to wave action. Some erosion was observed at the inlet to Pond 18; no additional erosion along the interior banks was noted. Erosion on the downstream slopes was difficult to observe due to excessive vegetation, in areas, and the presence of rip rap armoring on the slopes. The downstream slopes appeared to be in good condition with no visible erosion or head cutting of the embankment. Seepage at the toe of the embankment was observed along the north side of the pond. The most notable seepage was observed along the northeast side of the pond. Water observed from the seep appeared to have a red tint, but was generally clear.

A cursory review of the embankments for the other settling ponds indicates they are in the same general condition as the Pond 18 embankments. No apparent signs of settlement or slope instability were observed on the embankments. The downstream slopes were difficult to observe due to the presence of riprap. Seepage at the downstream toe was not observed, primarily because the Dolores River is situated directly at the toe of the downstream embankments. One point of concern noted during our site visit was the presence of timber debris within the Parshall flume at the outlet to Pond 5. It appeared the debris was causing the water level within the pond to rise resulting in alternate routes of discharge around the flume structure.

Conclusions and Recommendations

The sediment settling ponds at Rico Argentine Mine appear to be decently constructed and maintained. This judgment is based on a review of available information and the results of observations made during our site visit. Presented below are our recommendations specific to the settling ponds.

One of the primary purposes for the site visit was to observe the condition of the pond embankments and their ability to support dredging equipment. The embankments are relatively narrow at the crest, which may limit the size of equipment for dredging. The size of equipment is also a function of the embankment's ability to support the weight of the selected equipment. To determine the available capacity of the embankment to support dredging equipment, we recommend conducting slope stability analysis using the appropriate load and loading conditions.

Limited geotechnical information is available on the pond embankments. To conduct additional analysis of the embankment, specifically slope stability, we recommend conducting a field investigation to further characterize the pond embankments and evaluate their current condition. The field investigation is expected to include drilling test holes in the embankment to characterize the condition of the embankment and the soils used in the construction. Soil samples would be collected for laboratory testing to evaluate the parameters necessary to perform numerical analyses of the embankment, as discussed in this section.

Seepage was encountered at the toe of the Pond 18 embankment along the northeast side of the pond which may be impacting the Dolores River. We recommend that further design consideration be made to address the seepage by improving or modifying the embankments. Further consideration would be based on the current condition and geotechnical characterization of the embankment.

The current freeboard dimension for Pond 18 is approximately 1.2 feet. We recommend a wave run-up analysis be conducted to estimate the minimum freeboard dimension appropriate for the pond. We also recommend the elevation of the outlet works be adjusted to accommodate the minimum freeboard dimension. This recommendation could apply to all of the ponds.

As was mentioned previously, flow in the Dolores River is not expected to overtop the pond embankments for Pond 18 during or after the 100 year, 24-hour storm event. The water level in the river during runoff is expected to rise which could impact the integrity of the embankments that skirt the Dolores River. The impacts could include erosion of the embankment and slope instability due to saturation and rapid drawdown. The impact to the embankments, based on the increase and decrease of water levels within the Dolores River, should be further considered. We recommend analyzing the embankments under rapid drawdown loading conditions, if necessary, and further analysis of the erosional characteristics during periods of flow similar to the runoff resulting from the 100 year, 24-hour storm event.

Vegetation is present over a majority of the embankments; it is particularly dense on the North side of the pond(s), nearest the river. Trees and bushes with large root systems may provide preferential flow paths for water seeping through the embankments, increasing the potential for added seepage and slope instability. We recommend removing trees and bushes, and maintaining the embankments free of vegetation with exception to surface grasses which reduce the potential for erosion and provide shallow slope stability.

GENERAL INFORMATION

The condition of the settling pond(s) depends on changing internal and external conditions; they are evolutionary by nature. The present condition of the settling pond(s) may change and may not represent the condition of the pond(s) at some point in the future. Only through periodic inspections can unsafe conditions be detected so that corrective actions can be made. Likewise continued care and maintenance are necessary to reduce the possible development of unsafe conditions.

URS warranties that our services are performed within the limits prescribed by the EPA and UOS in a manner and care normally exercised by other consultants under similar circumstances. No other representation is implied and no other warranty or guarantee is included or intended.

CLOSING

We thank you for the opportunity to work on this project. If you have any questions or comments, please contact us.

Sincerely,

Michael E. Nelson, P.E.
Senior Geotechnical Engineer

Bob A. Christensen, P.E.
Senior Water Resources Engineer

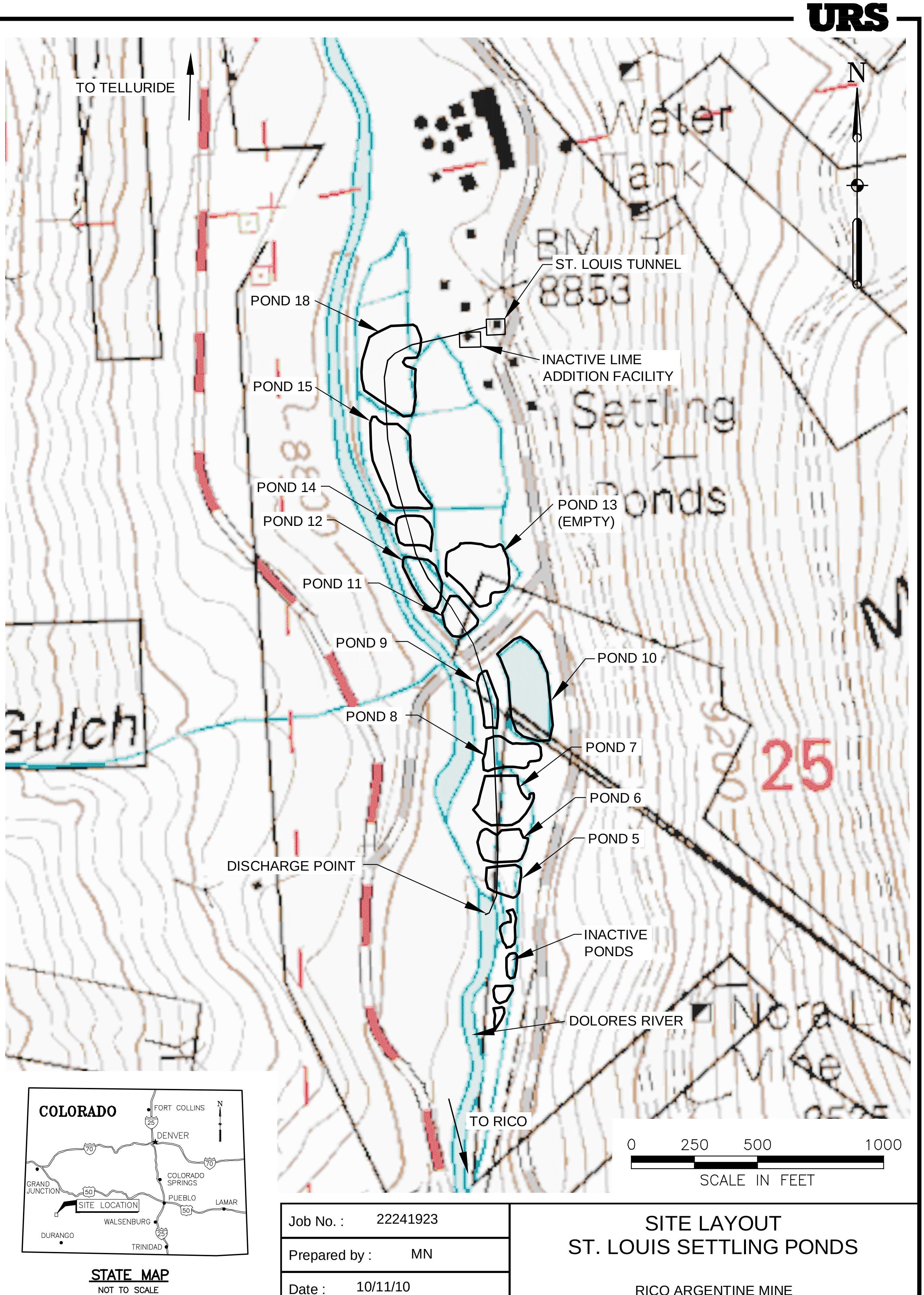
MEN:men

Attachments:

- Attachment 1 – Site Layout
- Attachment 2 – Flood Insurance Rate Map
- Attachment 3 – Results of Hydraulic Modeling
- Attachment 4 – Site Photos

ATTACHMENT 1

SITE LAYOUT



Job No. : 22241923	SITE LAYOUT ST. LOUIS SETTLING PONDS RICO ARGENTINE MINE
Prepared by : MN	
Date : 10/11/10	

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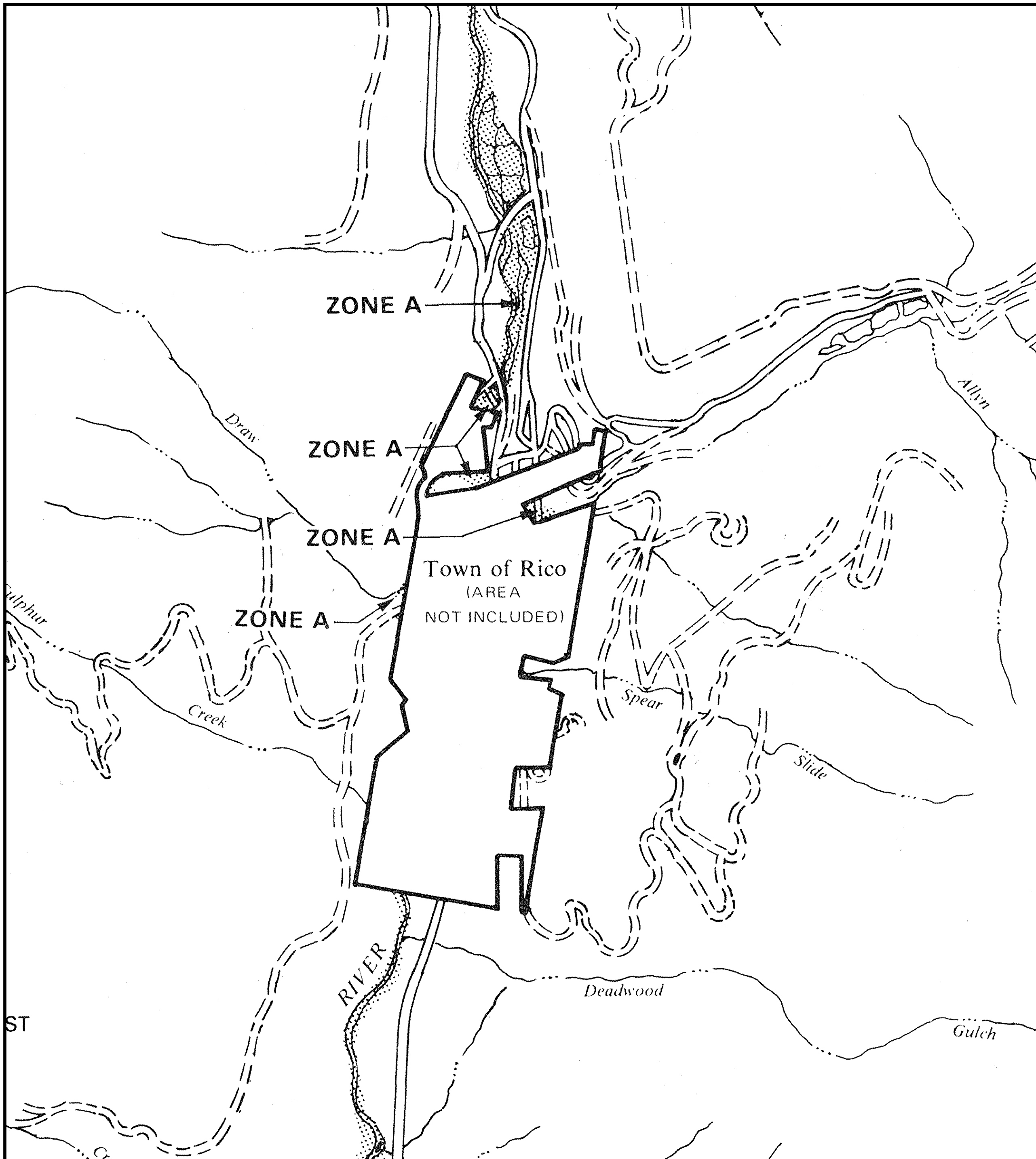
ATTACHMENT 2

FLOOD INSURANCE RATE MAP



APPROXIMATE SCALE IN FEET

2000 0 2000

DOLORES COUNTY, COLORADO

UNINCORPORATED AREA

PAGE 10 OF 12

(SEE MAP INDEX FOR PAGES NOT PRINTED)

EFFECTIVE DATE:

~~JANUARY 24, 1978~~

MARCH 01, 86

CONVERTED BY LETTER
EFFECTIVE 3/1/86

COMMUNITY - PANEL NO.

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U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

FEDERAL INSURANCE ADMINISTRATION

ATTACHMENT 3

RESULTS OF HYDRAULIC MODELLING

HEC-RAS Plan: exist River: Dolores Reach: SLT

Reach	River Sta	Profile	Q Total	Length Chnl	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
SLT	40	2-YEAR	470.00	1390.00	1041.51	1042.16	1041.99	1042.50	0.021098	2.54	101.65	102.00	0.79
SLT	40	5-YEAR	840.00	1390.00	1041.51	1042.69	1042.48	1043.12	0.018078	3.96	162.23	119.56	0.83
SLT	40	10-YEAR	1160.00	1390.00	1041.51	1043.03	1042.78	1043.54	0.017351	4.85	202.69	123.39	0.86
SLT	40	25-YEAR	1660.00	1390.00	1041.51	1043.47	1043.17	1044.11	0.016899	5.86	257.96	128.43	0.89
SLT	40	50-YEAR	2030.00	1390.00	1041.51	1043.77	1043.44	1044.49	0.016336	6.40	297.39	131.91	0.89
SLT	40	100-YEAR	2770.00	1390.00	1041.51	1044.21	1043.92	1045.15	0.017483	7.50	356.60	136.98	0.95
SLT	40	200-YEAR	2800.00	1390.00	1041.51	1044.23	1043.94	1045.17	0.017525	7.54	358.86	137.16	0.95
SLT	40	500-YEAR	3460.00	1390.00	1041.51	1044.61	1044.32	1045.70	0.017641	8.25	411.81	141.53	0.98
SLT	30	2-YEAR	470.00	505.00	1015.06	1018.50	1018.30	1019.21	0.014213	6.79	69.31	36.08	0.86
SLT	30	5-YEAR	840.00	505.00	1015.06	1019.54	1019.36	1020.33	0.015572	7.13	118.76	63.10	0.90
SLT	30	10-YEAR	1160.00	505.00	1015.06	1019.97	1019.86	1020.95	0.015877	7.97	147.31	68.13	0.93
SLT	30	25-YEAR	1660.00	505.00	1015.06	1020.50	1020.47	1021.80	0.015839	9.17	184.32	70.11	0.97
SLT	30	50-YEAR	2030.00	505.00	1015.06	1020.84	1020.84	1022.37	0.016078	9.97	208.20	71.35	0.99
SLT	30	100-YEAR	2770.00	505.00	1015.06	1021.58	1021.58	1023.40	0.014542	10.92	261.79	74.06	0.98
SLT	30	200-YEAR	2800.00	505.00	1015.06	1021.61	1021.61	1023.43	0.014507	10.96	263.80	74.16	0.98
SLT	30	500-YEAR	3460.00	505.00	1015.06	1022.16	1022.16	1024.26	0.014028	11.78	305.41	76.20	0.98
SLT	20	2-YEAR	470.00	815.00	1007.32	1009.89	1009.89	1010.68	0.020394	7.11	66.06	42.06	1.00
SLT	20	5-YEAR	840.00	815.00	1007.32	1010.67	1010.67	1011.75	0.018440	8.35	100.63	46.53	1.00
SLT	20	10-YEAR	1160.00	815.00	1007.32	1011.23	1011.23	1012.52	0.017487	9.09	127.60	49.74	1.00
SLT	20	25-YEAR	1660.00	815.00	1007.32	1011.96	1011.96	1013.53	0.016819	10.03	165.54	53.93	1.01
SLT	20	50-YEAR	2030.00	815.00	1007.32	1012.46	1012.46	1014.18	0.016247	10.53	192.76	56.75	1.01
SLT	20	100-YEAR	2770.00	815.00	1007.32	1013.31	1013.31	1015.34	0.014958	11.44	242.75	61.02	1.00
SLT	20	200-YEAR	2800.00	815.00	1007.32	1013.34	1013.34	1015.38	0.014931	11.48	244.63	61.17	1.00
SLT	20	500-YEAR	3460.00	815.00	1007.32	1014.00	1014.00	1016.29	0.014207	12.16	286.53	64.48	0.99
SLT	10	2-YEAR	470.00		991.58	994.18	994.02	994.80	0.015007	6.34	74.67	46.88	0.87
SLT	10	5-YEAR	840.00		991.58	994.89	994.78	995.82	0.015014	7.75	110.12	52.25	0.91
SLT	10	10-YEAR	1160.00		991.58	995.40	995.31	996.54	0.015003	8.63	137.36	56.03	0.94
SLT	10	25-YEAR	1660.00		991.58	996.22	996.14	997.43	0.015008	8.92	190.83	73.49	0.95
SLT	10	50-YEAR	2030.00		991.58	996.62	996.55	997.96	0.015009	9.44	221.27	81.43	0.96
SLT	10	100-YEAR	2770.00		991.58	997.25	997.25	998.90	0.014448	10.51	276.44	93.43	0.97
SLT	10	200-YEAR	2800.00		991.58	997.28	997.28	998.94	0.014369	10.54	279.08	93.97	0.97
SLT	10	500-YEAR	3460.00		991.58	997.86	997.86	999.66	0.012963	11.05	337.23	105.08	0.94

ATTACHMENT 4

SITE PHOTOS

Site Photos

1. Discharge from the St. Louis tunnel to holding pond above Pond 18.

2. Discharge from the St. Louis tunnel to holding pond above Pond 18.

Site Photos

3. Holding pond (front) above Pond 18 (back).

4. Culverts discharging from holding pond above Pond 18 into Pond 18.

Site Photos

5. Discharge culverts and spillway for Pond 18.

6. Discharge culverts and spillway for Pond 18.

Site Photos

7. Downstream spillway for Pond 18.

8. Broad-crest weir spillway.

9. Single discharge culvert situated beneath spillway.

10. Side-by-side discharge culverts near spillway.

Site Photos


11. Embankment between Pond 15 and Pond 18,with vegetation.


12. Pond 18 and embankments, looking west, existing piezometer in center of picture.

13. Seepage at the toe of the embankment along the north side of the pond, as shown in photo 15.

14. Seepage at the toe of the embankment along the north side of the pond, as shown in photo 15.

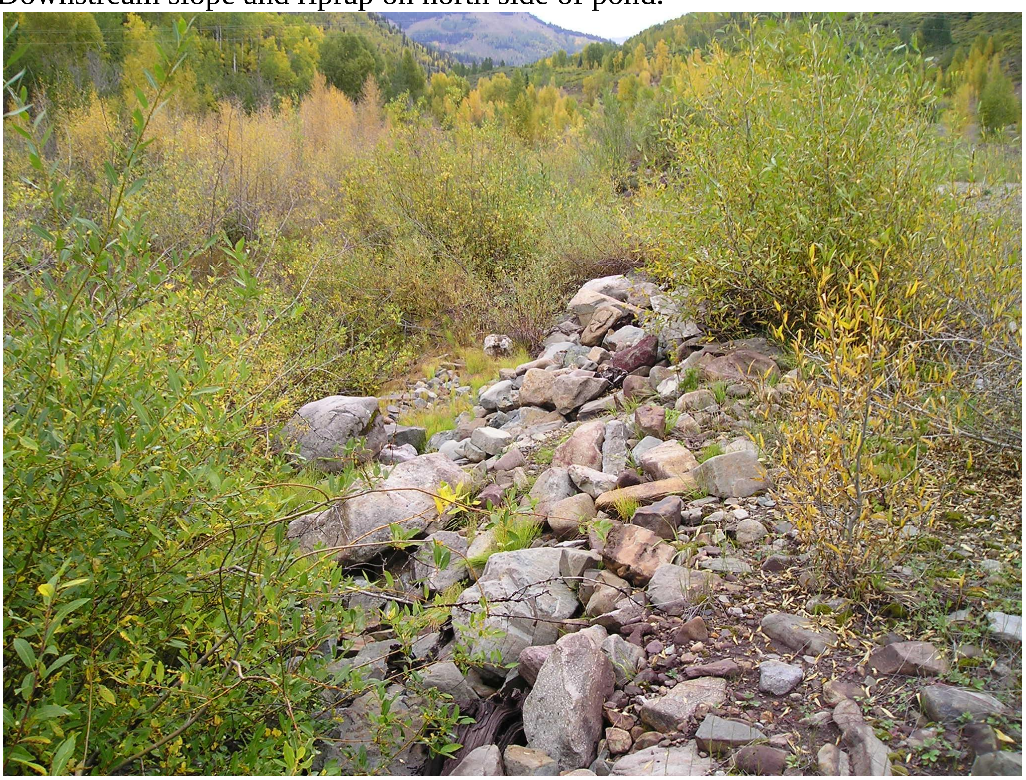
15. Location of seep shown in photo 18.

16. Seepage at the toe of the embankment along the north side of the pond.

17. Location of seep shown in photo 18.

18. Seepage at the toe of the embankment along the north side of the pond, as shown in photo 17.

19. Downstream slope and riprap on north side of pond.



20. Downstream slope and riprap on north side of pond.

21. Downstream slope and riprap on north side of pond..

22. Downstream slope and riprap on north side of pond.

23. Vegetation on the embankment.

24. Pond 18 and embankment, looking southwest.

25. Inlet culverts to Pond 18.

26. Discharge to Dolores River.

Site Photos

27. Discharge channel to Dolores River.

28. Discharge flume, facing upstream, Parshall flume in front.